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ABSTRACT

Arguing that scientific facts and insights can be used analogically to clarify literary analysis at specific moments, this paper presents a number of such facts and their analogical relationship to several literary passages. The examples cited relate the first and second laws of thermodynamics to scenes from "King Lear," rigid bodies in motion to passages from "Moby Dick" and "Huckleberry Finn," elastic collisions to scenes from "Hamlet," and the growth of snails to passages from "A Farewell to Arms" and "To the Lighthouse." (FL)

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NO GENE IS AN ISLAND:

ANALOGICAL RELATIONS BETWEEN SCIENCE AND LITERATURE

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No Gene Is An Island:

Analogical Relations Between Science and Literature

Undoubtedly, most readers will recognize the title of this article as a variation on a statement by John Donne, "No man is an island." Readers who do not recognize it will certainly respond to a later passage in the same work, "Ask not for whom the bell tolls..." The title is also a paraphrase of an assertion in a text on biology, "No gene acts alone." Analogically, then, the expression of every gene is influenced by one or more other genes and, as Donne assures us, every individual feels the advance and recession of other humans. Every gene is "part of the main" (more of Donne) manifesting this dependence in such ~~things~~ biological elements as blending or incomplete dominance. Every man is part of the main manifesting this dependence in reciprocal acts of love, hate, envy, wonder, and so forth. To extend this idea to literature: every literary character is part of the plot, expressing this relationship in acts and thoughts which will affect the fates of the rest of the characters. Thus, scientific facts and insights (in this instance biological) can be used analogically to clarify literary analysis at specific moments and it is the purpose of this paper to present a number of such facts and their analogical relationship to several literary passages. Though poets have occasionally made use of science, critics rarely have[1] and so I draw these analogies with a sense of experimentation. Yet, I feel a rightness, an appropriateness, in the experimentation. Literary analysis under any circumstances is a hazardous enterprise and in the classroom, whether secondary or college, it can become

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[1]At present I can think of only two critical statements which make use of such material: T. S. Eliot in "Tradition and the Individual Talent" applied the chemical theory of the catalyst to the poetic creative act. Emerson, somewhat obscurely, mentions the law of masses in attempting to explain his reactions to Chaucer's Romaunt of Love, to Shakespeare, and to Milton. Journal, Vol. 6 eds. E. W. Emerson and W. E. Emerson (Houghton Mifflin, 1911), p. 155.

particularly menacing.

The idea of establishing analogical relations between literature and science was born one day in a class in poetry. We were discussing, or more accurately, I was discussing Herbert's poem 'The Pulley' with little success when a student offered to demonstrate the theory of a pulley. Using the string attached to the window shade, the fixed pulley through which the string passes, and the shade itself, he demonstrated the manner in which a pulley works. I don't recall what the demonstration did for the poem as vividly as I do the class' lively interest in the demonstration and its possible relevance to the poem. Since that time I have searched for analogies between literature and science and have used them in class. In addition, students have not only brought into my literature classes ideas which they have encountered in their science courses but have also presented demonstrations in the hope of clarifying a literary text. At times the use of such analogies in the classroom may have the air of drawing imaginary rabbits out of transparent hats but the very nature of literary criticism, of which analysis is a part, requires a constant search for new tools by which to probe literature for its meanings. The decision as to whether the following examples are new tools or old ones with new handles I leave to the reader.

The First and Second Laws of Thermodynamics

Briefly, and therefore probably dangerously, the first law can be stated in this way: (my italics)

> From a similar investigation of all the other known physical and chemical processes, we arrive at the conclusion that nature as a whole possesses a store of energy which cannot in any way be either increased or diminished; and that, therefore, the quantity of energy in nature is just as eternal and unalterable as the quantity of matter. Expressed in this form, I have named the general law "The principle of the conservation of energy."[2]

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[2] Leon N. Cooper, An Introduction to the Meaning and Structure of Physics (New York: Harper & Row, 1968), p. 322.

The statement presents a condition that encourages a comparison to Renaissance tragic drama, let's say King Lear. When the play opens there is an almost immediate creation of disorder. The king, against the wishes of others, divides his kingdom into two parts between his two older daughters, rejecting his third daughter, Cordelia, because she will not exaggerate her love for him. Once the two older sisters have their shares they reject Lear who then begins to grow mad. Cordelia marries the King of France, returns to dethrone her sisters, is imprisoned and dies reconciled to her father who also dies in prison. The older sisters also die, one by poisoning and the other a suicide. In the subplot the Duke of Gloucester rejects his older son, Edgar, and favors his bastard son, Edmund, who has turned him against Edgar. At the conclusion Edmund is reconciled to Edgar and Edgar to his father. Clearly, the play, like the conditions described in the first law of thermodynamics, moves from disorder to order. It culminates in punishment to the wicked and serenity and understanding to the virtuous. Though evil and violence have been perpetrated the moral world remains balanced, poised. The optimism that is conveyed by the contention that "the quantity of energy in nature is just as eternal and unalterable as the quantity of matter" is matched by that which emerges from our realization that if at times we are to the Gods as Gloucester tells us in King Lear "as flies to wanton boys, they kill us for their sport," in the end we are, as Edgar suggests, victims of our own frailties in a just world: "The gods are just, and of our pleasant vices, Make instruments to plague us."

The second law of thermodynamics has no analogical meaning for this kind of drama but does for the literature of naturalism. This law is concerned with a quality called entropy. In a sense, entropy is a measure of disorder, or randomness. The more disorder, the higher the entropy; the greater the

organization of the system, the lower its entropy.[3] Matter and energy can become disorganized, matter by becoming more randomly arranged, energy by being degraded into heat. If the first law is a source of optimism in its argument for the restoration of order and the conservation of energy, the second is just as obviously a source for pessimism. As Cooper points out it is a concept "that has been associated with the disillusionment of a society no longer reaching toward perfection but running downhill toward mediocrity; a culture with television and without genius, an architecture with suburbia and without Notre Came (Cathedral)."[4] Consider the analogical relationship of the law to a naturalistic novel, Sister Carrie. From the very beginning of Carrie's departure from her small town and mean life there, Dreiser is relentless in pronouncing the futility of her chances to achieve success, citing the irresistible appeal of the dreadful city, the slow corruptive power of money, the frustration of moral enterprise. At the close of the novel his most gloomy prophecies are fulfilled. Everything has gone downhill. Hurstwood, the major male character, has abandoned his home and family, stolen money, and run away to New York with Carrie. The subsequent dissipation of his money, health, and spirit is as steady and relentless as the passage of time. Carrie's fate is not much better. Her rise to acting success is accompanied by a brutal disdain for humans and though at the close of the novel she has a view from the top, it is from the rocking chair whose rhythm and limited motion are symbols of a weary life dully contemplating a tired city, people, and economic system.

Dynamics: Rigid Bodies in Motion

The Gyroscope

One of the most moving images in Moby Dick occurs within Father Mapple's

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[3] D. D. Koob and W. E. Boggs, The Nature of Life (Reading, Mass.: Addison Wesley Co., 1972), p. 77.

[4] Meaning and Structure of Physics, 323.

sermon in chapter nine. In relating the story of Jonah and the whale he refers to Jonah's sense of guilt with an image which has its own scientific law:

> Screwed at its axis against the side, a swinging lamp slightly oscillates in Jonah's room; and the ship, heeling over towards the wharf with the weight of the last bales received, the lamp, flame and all, though in slight motion, still maintains a permanent obliquity with reference to the room; though, in truth, infallibly straight itself, it but made obvious the false, lying levels among which it hung. The lamp alarms and frightens Jonah; as lying in his birth his tormented eyes roll round the place, and this thus far successful fugitive finds no refuge for his restless glance. But that contradiction in the lamp more and more appals him. The floor, the ceiling, and the side, are all awry. 'Oh! so my conscience hangs in me!' he groans, 'straight upward, so it burns; but the chambers of my soul are all in crookedness!'

Just as Melville used the principle of the lamp and flame to present character, the teacher can use the analogy of the gyroscope to explain a literary passage, for example the 'letter' episode in Huckleberry Finn. The gyroscope is a wheel mounted on frictionless bearings in such a way that the wheel is free to turn in any direction with respect to the frame holding it. To do this, three gimbals are needed (corresponding to our three-dimensional space). To the extent that the bearings are frictionless, no torques (forces that produce rotation) are exerted on the gyroscope wheel. This means that once spinning, the axis of rotation will remain fixed in space so that no matter what motion may be given to the outer frame, the direction in space of the gyro axis will not vary.

The 'letter' episode in Huckleberry Finn occurs while Huck and Jim are floating down the Mississippi on their raft. Huck had taken to the raft in order to escape a society which he considered hypocritical. While floating down the river he is a witness to brutality, cowardice, deceit, betrayal, indifference. In the midst of this he must decide whether or not to write to Miss Watson to inform her of the whereabouts of her escaped slave, Jim.

After an anguished struggle he decides that he will not betray Jim. Huck's society, like the outer frame of the gyroscope, moves in multiple and torturous ways and Huck is not only a witness to but a participant in these movements. Yet, even as the society spins erratically through time and space, Huck's conscience (the gyro axis) does not vary in its direction.

Elastic Collisions

> If the forces between two bodies are such that their magnitude and direction depend only on the separation between the two bodies, the kinetic energy before the collision will be equal to the kinetic energy after the collision.[5]

When, for example, two billiard balls collide they are temporarily dented but spring back to their original shape. They are elastic and therefore suffer no loss of energy in the collision. Further, they have no internal structure and therefore can suffer no deformation. When two soft, clay balls collide, however, they do not spring back to their original shape. They are inelastic and therefore suffer a loss of energy. In addition, because they have an internal structure they can experience deformation. Somewhat similarly, static characters in a literary work are those who undergo no change (e.g., Horatio, in Hamlet, Nick Carraway in The Great Gatsby, Joe Gargery in Great Expectations). Horatio is an admirable, interesting character. But he is also static. At the beginning of the play on being told that evil powers are inactive during that season "Wherein our Saviour's birth is celebrated," he replies "So have I heard and do in part believe it." Throughout the play the air of intense but controlled involvement which characterizes this remark is sustained by Horatio. Like Horatio, though they may be witnesses to and participants in the events which destroy the major character, static characters remain the same. They are elastic and therefore suffer no loss of energy, have no internal structure and therefore suffer no deformation. Dynamic characters,

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[5] Meaning and Structure of Physics, p. 113.

however, change. Tragic characters undergo enormous change. Like the clay balls they are inelastic and therefore suffer a loss of energy. They have complex internal structures and therefore suffer deformation. Hamlet's 'collision' with the murder of his father and the marriage of his mother to his uncle permanently 'dents' him. He experiences a loss of energy because he is unable to return to his previous condition but instead must alter himself toward revenge. He has, too, an internal structure, a structure which is susceptible to permanent 'denting' and therefore to deformation.

Hamlet's propensity for deliberation recalls still another source for analogy, that of the pendulum. A pendulum at the peak of its swing pauses an instant. At this stage it has zero kinetic energy and maximum potential potential energy. At the nadir of its swing it has minimum potential energy and maximum speed. A tragic hero often pauses at the climax of a scene or of a work, momentarily poised, spiritually, intellectually, even physically, before making a decision or performing an act. Hamlet debates, "To be or not to be," Conrad's Lord Jim pauses momentarily on the rail of the ship before deciding to leap to safety (and to personal disaster), and Ahab in one of his last moments of calm reflection soliloquizes while leaning over the bulwarks and then flings his pipe into the ocean in a symbolic gesture of renunciation of calm reflection. At the nadir of the pendulum's swing it has minimum potential energy but maximum speed with which to do work, that is, to strike another object and do work on it, impart energy to it. After his decision to trap the king by means of the play, Hamlet reaches the nadir of his 'swing' and accomplishes his goal, to destroy the king.

The Growth of Snails

This analogy drawn from biology may have little romantic appeal but could

clarify the actions of a literary hero, particularly a tragic one. Modern snails (gastropods to biologists) have spiral rather than conical shells and they form them in a fascinating way.

> If two points are a certain distance apart, and one moves around the other, a circle is generated. The circle is transformed into a spiral if the moving point approaches or moves away from the central point as it revolves. The moving point may be considered the point at the middle of the shell aperture, moving with respect to the apex of the shell as the animal grows.[5]

In Hemingway's A Farewell to Arms, Frederic Henry is one point and his ultimate tragedy is another. Frederic is aware of both points. He repeatedly calls attention to his own responses and condition and to the fate of all good people. "They," the world's forces, got you in the end. If you stayed around long enough, he assures us, they broke you. To be broken is inevitable. Nevertheless, tragedy must be spiral, not direct. The tragic hero forms his life as the snail his shell, his direction moving away from the central point which is his tragedy as he attempts to avoid or merely postpone his fate. Frederic circles his fate by various gestures: a refusal to commit himself to either side of the war (he joined the Italians because he spoke the language), a love affair, desertion from the Italian forces, flight to a neutral country. But as he circles he progresses toward the point of tragedy which like the central point in the snail's aperture is always ahead of him. In addition, it is interesting to note a possible association between the structure of the snail's shell and the story's plot. The width of the whorls of the snail's shell is determined by the acceleration of the snail's groth. A slow acceleration produces a series of wide whorls, a rapid acceleration a series of narrow ones. Somewhat similarly, the episodes in a plot are determined by the acceleration of the movements of the major figure. The major figure in a

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[5]Paul A. Meglitsch, Invertebrate Zoology. (New York: Oxford University Press, 1967), p. 489.

novel like A Farewell to Arms or Tom Jones creates a series of events which are accelerated at an even rate and produces, to use the biological term, a series of uniform whorls. The major figure in a novel like Virginia Woolf's To The Lighthouse does not produce such a plot but, rather, one composed of almost imperceptible segments of responses, attitudes, and emotions.

Of course analogies can be perilous. Certainly, I do not wish to present false analogies, contending that the likenesses are complete for they are not. Nor do I wish to imply generalization by the analogies. They do not apply to all literary works. And, to continue to speak of what I'm not doing, I'm not using analogies argumentatively to persuade anyone that one passage or character or book is better than another passage, character, or book. I do wish to present the examples above for two major reasons. First, it is important to know literature and science and analogies can motivate students to examine both more closely, not only for their analogical relationships but for themselves. Second, analogy brings us to the analogical process itself and to its importance as a learning method. The analogical process involves specific relationships and aims at specific goals but it relies upon the assumption of general principles or propositions that make the reasoning possible. The process begins with placing the items for comparison in a general field. The next step postulates that the items have certain common characteristics. Therefore the development of such reasoning involves both induction and a hypothesis covering the field represented by these cases and then specific inferences concerning the unknown elements of the particular analogy under investigation.

The extension of the analogy, whether or not it involves the unknown elements, varies considerably. The analogy of the gyroscope has a good potential for extension and an absorbing article by Wolfgang Langewiesche, "Flying Blind," will suggest this.[6] Prior to the invention of the gyroscope when a

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[6] The Essay, ed. John L. Stewart (New Jersey: Prentice-Hall, 1952), pp. 51-67.

flier was trapped in overcast he could climb but a moment later "would fall back out of the clouds in a crazy, snarling dive." This was the result of a complicated maneuver of the plane growing out of a 'turn.' Planes do not go straight but naturally circle. "Once circling, every airplane wants to increase its bank and tighten the circle, and at the same time drop its nose and pick up speed--unless the pilot holds his controls against this overbanking tendency." It is a balanced maneuver of the plane in which the pilot's sense of balance remained. The pilot, however, did not perceive that his balance remained undisturbed. Believing that something unnatural had occurred, the pilot would attempt to pull up the nose of the plane only to force it more tightly into the turn. The gyroscope solved the problem by indicating to the pilot that all was well. "Leading its strange, semi-independent existence in space, the whirling little mass does not follow along willingly as the airplane turns. It rears up in its frame, and thus makes the needle lean to the side toward which the airplane is turning." It assured the pilot that the plane was turning now to the left, now to the right, now flying straight. Blind flying was now possible.

However, the problem did not end there for the pilot must now rely on an instrument rather than instinct and this led to a difficulty which Langewiesche describes dramatically and which suggests the richness of the gyroscope analogy.

> As you cruise along, turn indicator centered, everything in order - your sense of balance so long unemployed, disregarded and mistreated, now raises mischief with surprising insistence. It whispers that you are on your side - when you know you are not. And gradually you get split in two. Your eyes, your intellect, your hands and feet follow the instruments and fly the airplane straight and level. The rest of you slowly gives in to the crazed sense of balance, and after five minutes you begin to lean over sidewise in your seat, trying to keep yourself perpendicular in an imagined frame of reference. After twenty minutes you look as if you were bending over to pick something off the floor, and your head is nearly horizontal. And still your training keeps you flying straight. You don't realize

> that you are leaning. You realize only that you are under heavy strain, and you feel that you are flying on its side simply because the instruments tell you to do so - it can't be right. The longer the hallucination lasts, the more vivid it becomes. Unless you break it off, you are bound finally to give in, level your wings in imagined space, and thus in real space to spiral off.

How much more analogical meaning the gyroscope assumes from this perspective: The gyroscope as a code, a standard existing independent of man's idiosyncracies. The gyroscope's involvement in the conflict between man's senses and a "higher law," to use Thoreau's phrase. Man's persistence in following his own limited vision in the face of a more accurate one. The tension between man and technology. The proximity of doom in man's reluctance to place faith in an object outside of himself.

On the other hand, the analogy of organic growth is limited. Coleridge's distinction between organic form and mechanical form (in literature) is an arresting one and obviously begs for an analogy in the natural sciences. "The organic form," he wrote in Lectures on Shakespeare, is innate; it shapes, as it develops, itself from within, and the fullness of its development is one and the same with the perfection of its outward form. Such as the life is, such is the form." The following comment on growth in plants could serve as a starting point for an analogy to Coleridge's theory of organic literary form. (My italics)

> The total development of a plant from a fertilized egg to a mature organism involves more, however, than mere increase in size; otherwise the bodies of plants would be shapeless masses. Development also involves morphological and chemical differentiation according to a hereditary pattern, and increase in size is normally accompanied by increase in structural and chemical complexity. Internally, cell division and cell enlargement are succeeded by differentiation, which produces a great variety of cells organized into tissues and organs. External differentiation results from greater growth in one direction than another, producing the shape and form that disting one kind of plant from another.[7]

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[7] Carl L. Wilson and Walter E. Loomis, Botany, Fourth Edition (New York: Holt, Rinehart and Winston, 1967), p. 221.

Beyond the possible analogical relationship of Coleridge's comment and the italicized part of the quotation, the matter encounters difficulties, not the least of which are the realities of cell division and a definition of organic in terms of compounds containing carbon. Similarly, the Law of Inertia for Rigid Bodies has fascinating analogical possibilities and limitations for clarifying the spiritual and intellectual equilibrium of a literary character beset by adversity but I leave that intriguing problem for any reader interested enough to track it down.

Consideration ofthe purposes for which analogical relationships are made may make irrelevant the limitations of discovered analogies. The major value may reside in the search itself.